# Three Way Meeting APS/Spring-8/ESRF
# APS, ANL 2-3 June 2003

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## ESRF

- Current Status
- Medium Term Strategy
- Long Term Strategy

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# Current Status

# The European Synchrotron Radiation Facility

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- Service institute: 4500 - 5000 user visits annually
- Active in-house research programme
- ~ 1200 experimental sessions per year
- ~ 40 synchrotron radiation beamlines
- Staff complement ~ 570
- Annual budget ~ 72 M€ (~ 83 M$)
- 17 Member or Associated Countries

# ESRF Members and Scientific Associates

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Contribution to ESRF budget
(and share of beam time)

| | |
|---|---|
| • France | 27.5% |
| • Germany | 25.5% |
| • Italy | 15% |
| • UK | 14% |
| • Belgium/Netherlands | 6% |
| • Spain | 4% |
| • Switzerland | 4% |
| • Denmark/Norway/ Sweden/Finland | 4% |
| | 100% |

| | |
|---|---|
| Associated Countries | 3.58% |
| • Portugal | 1% |
| • Israel | 1% |
| • Austria | 1% |
| • Hungary | 0.2% |
| • Czech Republic | 0.38% |

# ESRF Staff

Total of 570 staff:

- 215 scientists and engineers
- 185 technical staff
- 55 postdocs
- 30 PhD students
- 85 administration, support, directors….
- ~ 58% French staff

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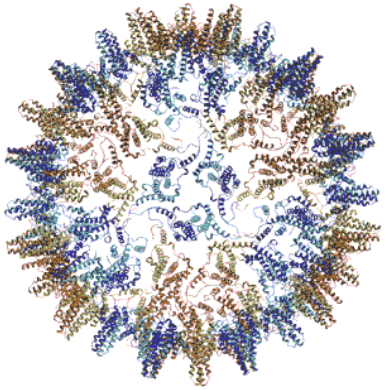
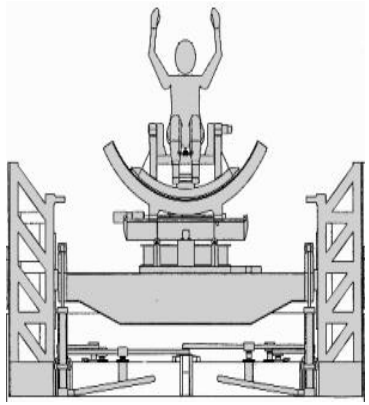
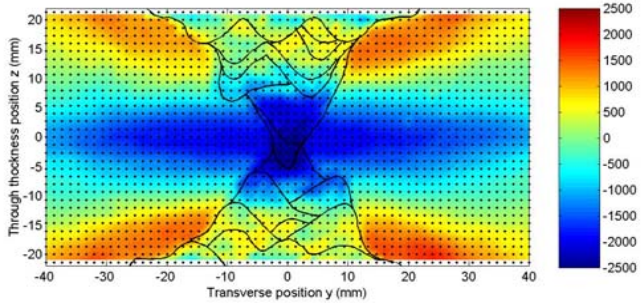
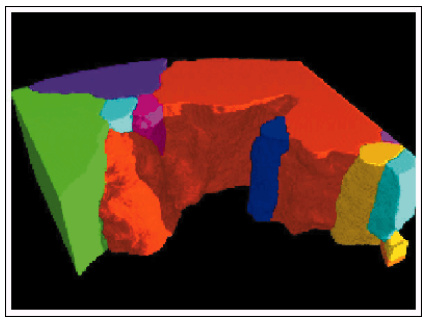
# Science and Beamlines

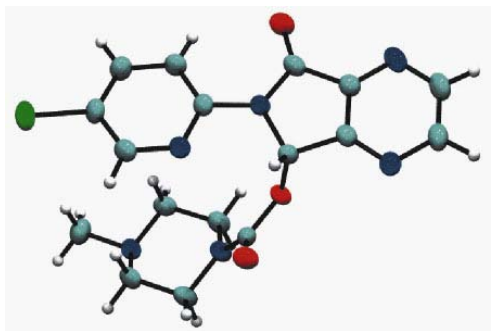
# ESRF Science

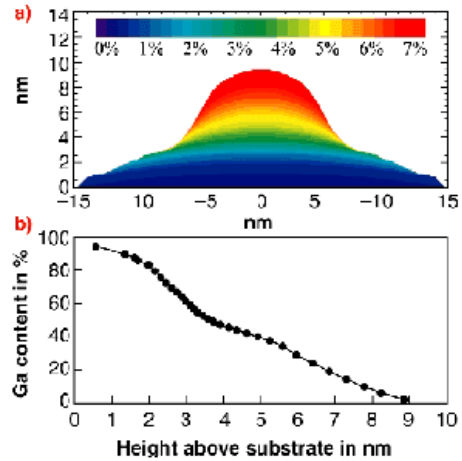











Biology/life sciences ⇨ medicine ⇨ engineering ⇨ materials ⇨ chemistry ⇨ physics

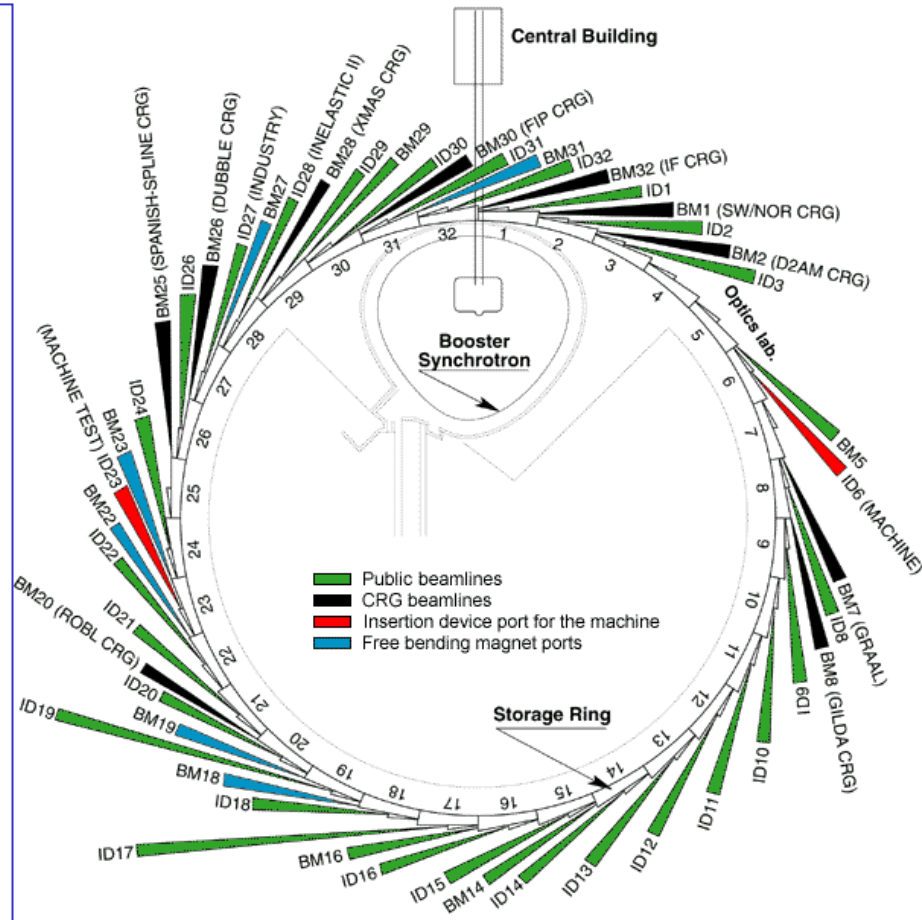
# ESRF Beamlines

ESRF operates “30” beamlines

- 33 insertion device end-stations
- 2 insertion device end-stations under construction
- 2 bending magnet end-stations

In addition there are

- 13 bending magnet Collaborating Research Group (CRG) end-stations
- 1 CRG beamline commissioning
- 1 CRG beamline under construction (2 end-stations)



# ESRF Beamline Groups

| Group | Beamlines |
| --- | --- |
| • Surface & Interface Science | ID01, ID03, ID32 |
| • Soft Condensed Matter | ID02, ID10A, ID10B, ID13 |
| • X-ray Imaging | ID17, ID19, ID21, ID18F, ID22 |
| • Macromolecular Crystallography | ID14A, ID14B, ID29, ID23 |
| • X-ray Abs. & Magnetic Scattering | ID08, ID12, ID20, ID24, BM29 |
| • High Res. & Resonance Scattering | ID16, ID18, ID22N, ID26, ID28 |
| • Materials Science | ID09TR, ID09HP, ID11, ID15A, ID15B, ID30, ID31 |

# Collaborating Research Groups (CRG)

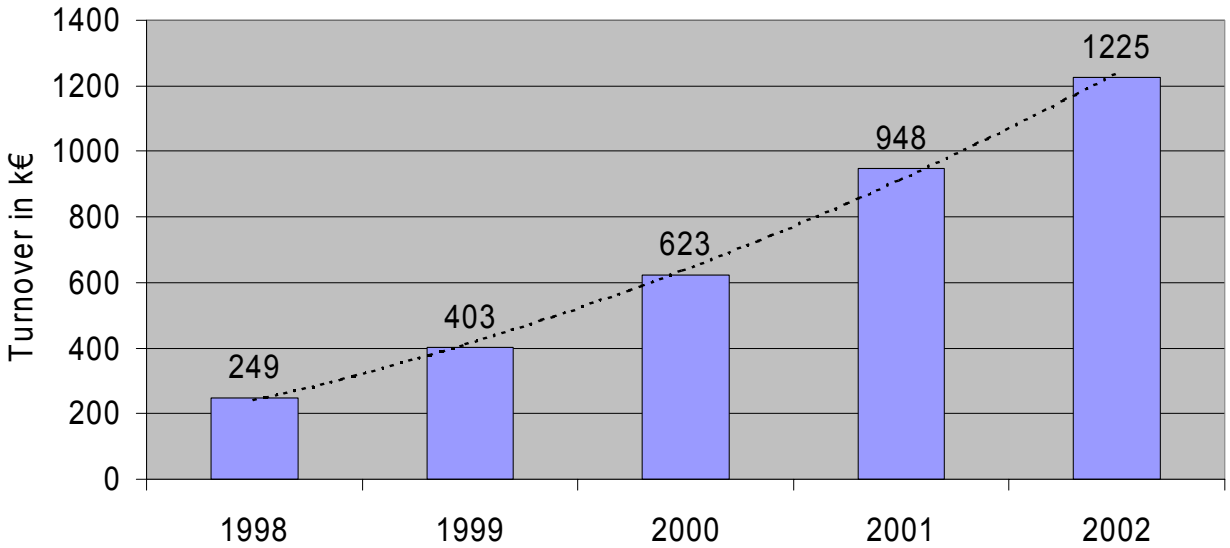
| | | | |
|---|---|---|---|
| • BM01 | Switz.-Norway | SNBL | Diffraction, XAS |
| • BM02 | France | D2AM | Diffraction, anomalous scattering |
| • BM07 | Italy | GRAAL | Gamma-ray, photoproduction |
| • BM08 | Italy | GILDA | Diffraction, XAS |
| • BM14 | UK | | PX/MX (MAD) |
| • BM16 | Spain | | PX/MX, SAXS, WAXS |
| • BM20 | Germany | ROBL | Radiochemistry, materials |
| • BM25 | Spain | SPLINE | PD, XAS, PX/MX |
| • BM26 | Nether.-Belg. | DUBBLE | SAXS, WAXS, PX/MX, XAS, ID |
| • BM28 | UK | XMaS | Magnetic and high-resolution scatt. |
| • BM30 | France | FIP/FAME | PX/MX (MAD), XAS |
| • BM32 | France | IF | Surfaces and Interfaces |

# ESRF Scientific Output

- ~ 1000 refereed publications in 2001
- ~ 40 papers in Nature and Science
- ~ 50 papers in PRL and EPL
- ~ 90 papers in PR
- ~ 800 refereed publications in 2002 (registered, to date)

# ESRF Industrial and Commercial Unit

Beamtime Sales 1998-2002 (k€)




- Income 2001 0.95 M€
- Income 2002 1.22 M€
- Estimate 2003 1.5 M€

( ~ 2% of total budget)

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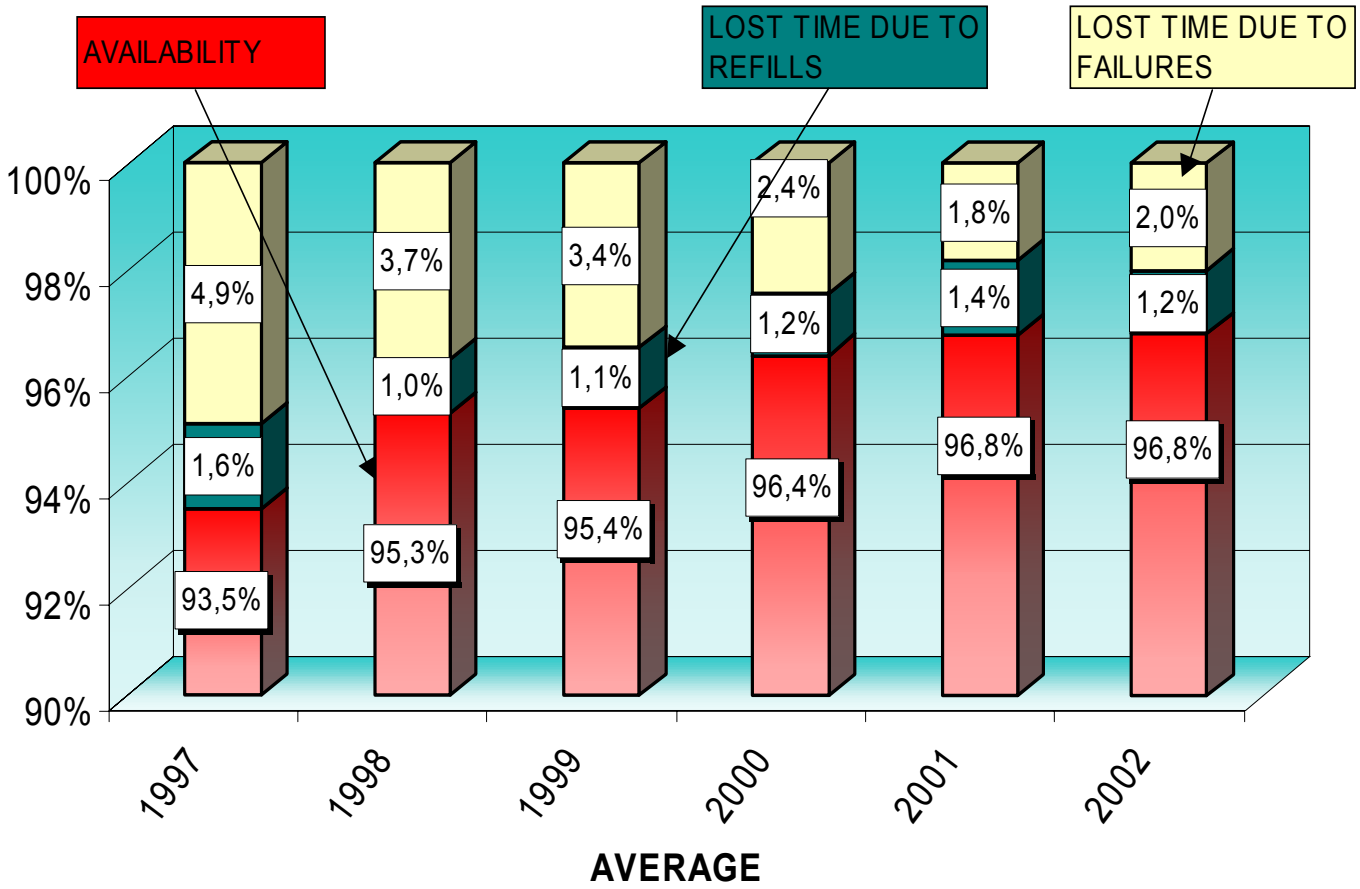
# X-ray Source

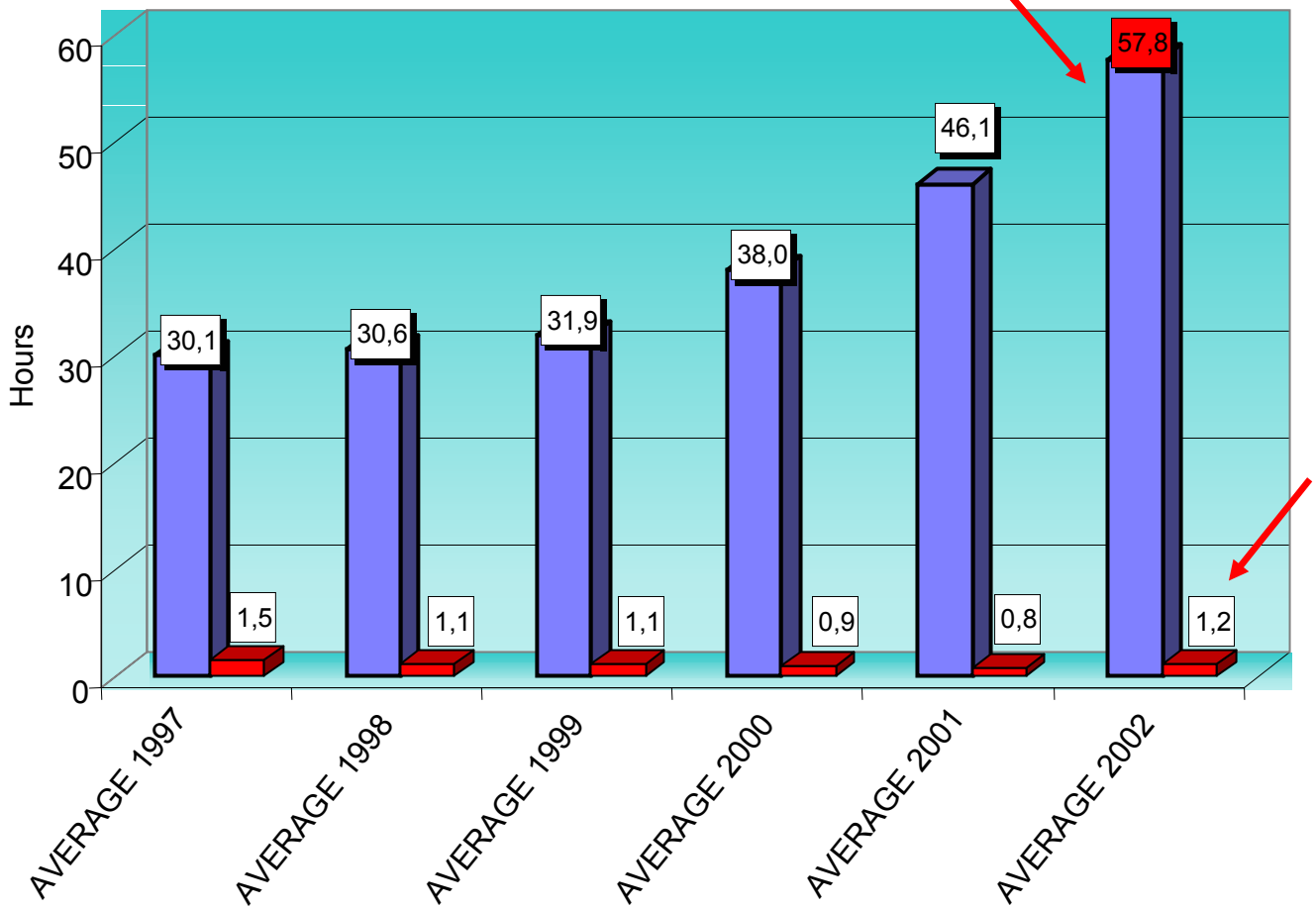
# ESRF Machine Availability



# Machine MTBF

## Mean Time Between Failures

9 periods of delivery > 120 hours without failure




Mean duration of a failure

# X-ray source developments

- **Injection with front-ends open**
  - New radiation monitors on all beamlines
  - First implementation 5 February – now routine operation
  - Effective increase of beamtime (optics always “hot”)
- **Increase of current**
  - Design - 100 mA, operation - 200 mA
  - Shielding modifications complete
  - Optimise operation at 250 mA
  - Increase current $\rightarrow$ 300 mA (limit ?)

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# Medium Term Strategy

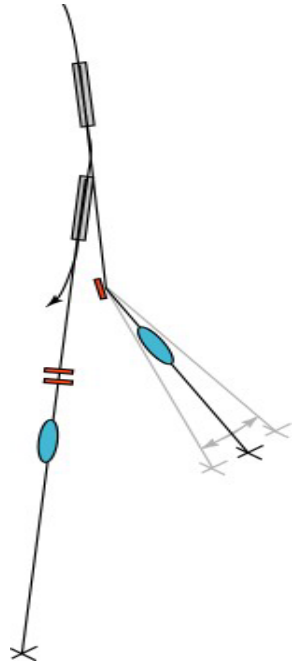
## (Medium Term Scientific Programme)

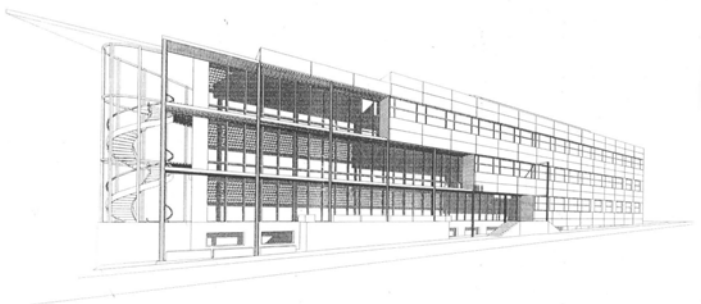
# Medium Term Scientific Programme

- Partnership for Structural Biology (PSB): ESRF/EMBL/IBS/ILL
- High Magnetic Fields
- Engineering and Materials
- Nanoscience
- Infrared Microscopy Station
- Integrated Synchrotron Radiation Training Center
- High Resolution Photoelectron Spectroscopy
- Theory group: new numerical methods and tools
- Continued Enhancement, Refinement and Development programmes

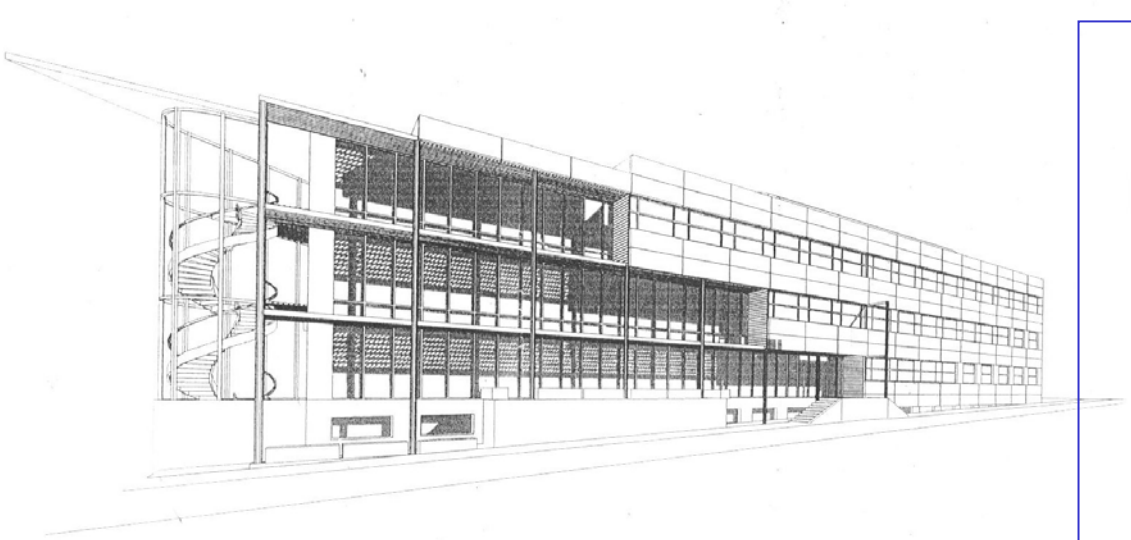
# Partnership for Structural Biology

- Collaboration in structural biology between ESRF, EMBL, ILL, IBS (IVMS)
- Combining expertise and infrastructure
- Scientific collaboration focused on human health
- New beamlines (ID23) and lab/office building
- ESRF MX/PX beamlines: ID14(4), ID29, CRGs…





# Partnership for Structural Biology
# The Laboratory/Office Building



House PSB facilities + IVMS

- High-throughput protein production
- Quality control
- Crystallisation
- Labelling facilities
- Computing
- Visitor space
- 1670m$^2$ laboratory space
- Budget 5.2 M€

Beamline:2002 - 2004

Building: 2003 - 2005

# High Magnetic Fields
# ID20 Upgrade: steady-state fields (2003-4)

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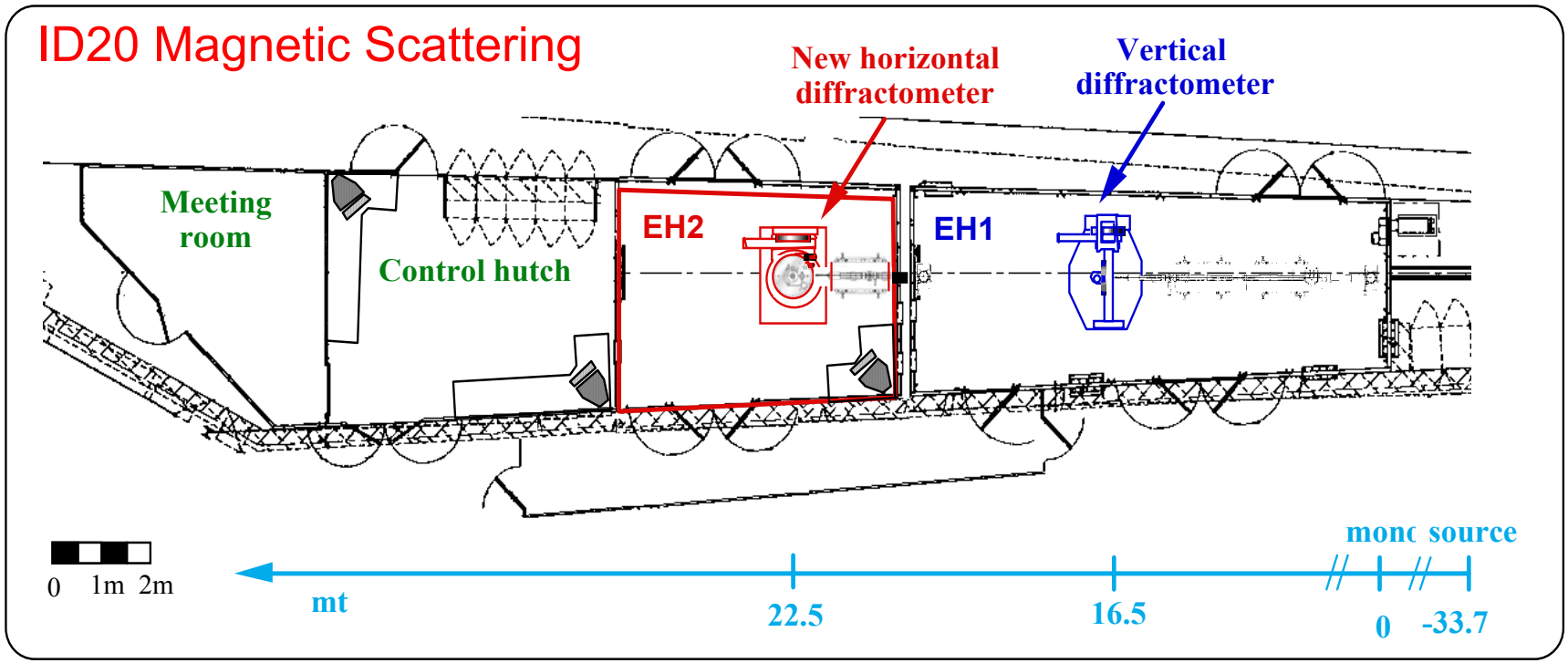


- Second experimental hutch, EH2, completed
- New **non-magnetic** diffractometer, ordered
- **Vertical field** (10T) cryomagnet, ordered
- Horizontal field (3.5T) cryomagnet, available

# High Magnetic Fields  Pulsed Field Project

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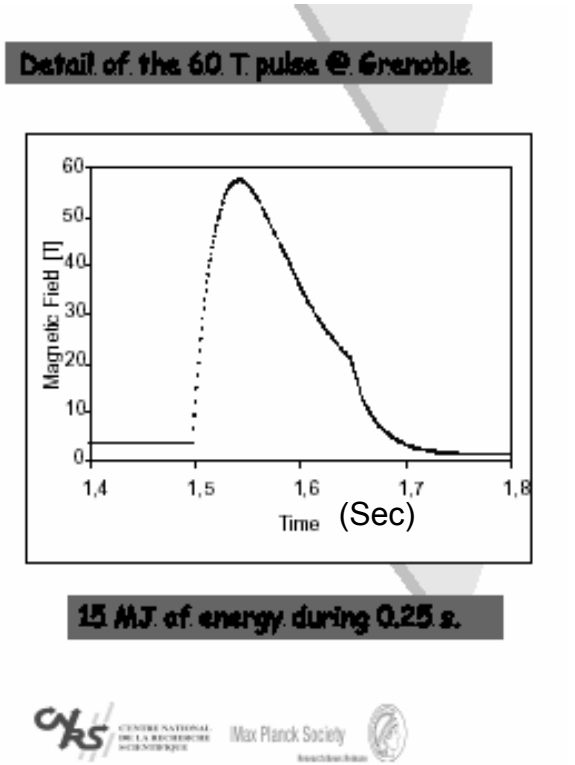



CNRS CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE  Max Planck Society

## Parameters to be investigated

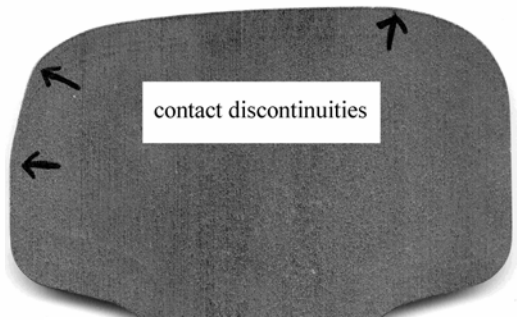
- Magnetic field (max, pulse length, repetition rate …)
- Bore, entrance/exit apertures
- Mechanical stability
- Temperature (min, max)
- Costs
- Timescale: ~ 2004 - 2007

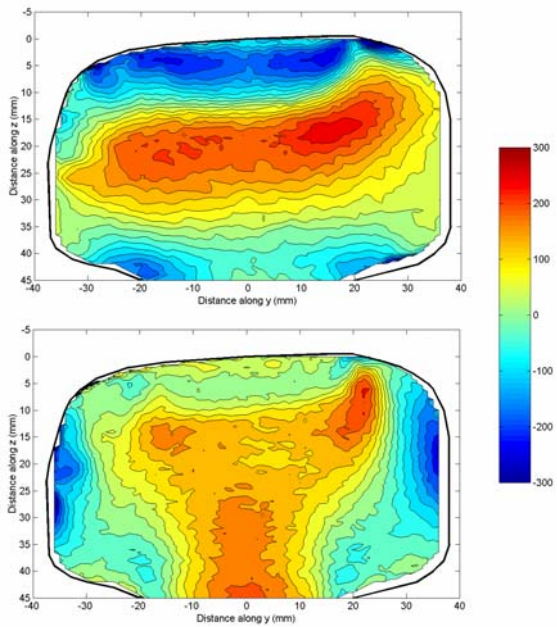
- **Structural changes** accompanying magnetic ordering, **spectroscopy** (XMCD, EXAFS,…)
- **Science beyond 15 T**: low-D magnets, heavy fermion systems, CMR, HTC, intermetallics … (strong electron-electron, electron-lattice interactions)
- **Collaboration with Grenoble High Magnetic Field Lab (MPI/CNRS)**

# Engineering FAME38 Project (2002-7)


- Collaboration with ILL and group of UK Universities
- To generate an *environment on joint ILL/ESRF site to encourage and support engineering research by engineers*
- To facilitate *industrial and commercial exploitation* of ILL and ESRF instruments

# Engineering FAME38 Project

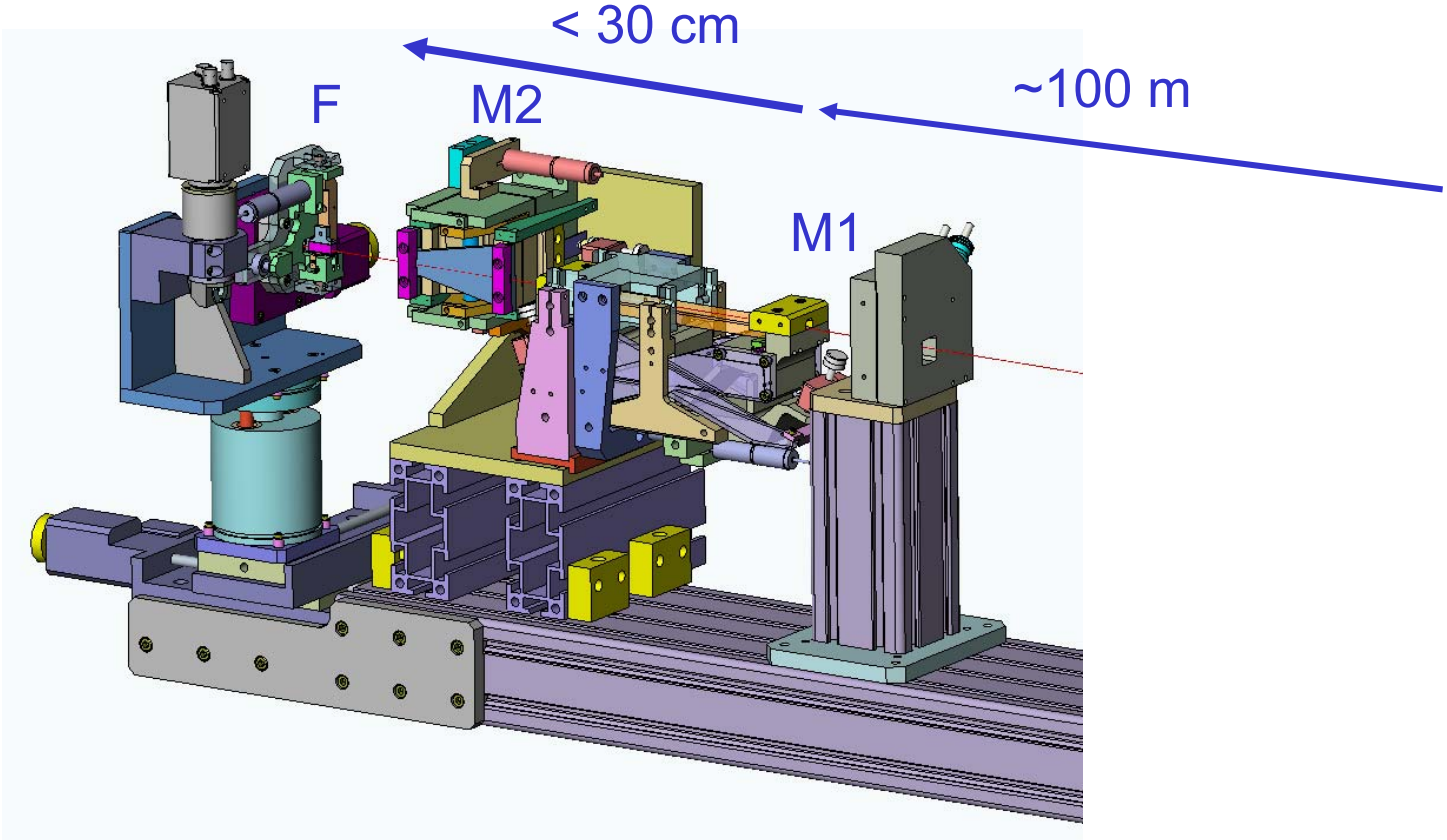




Transverse and vertical residual stress maps

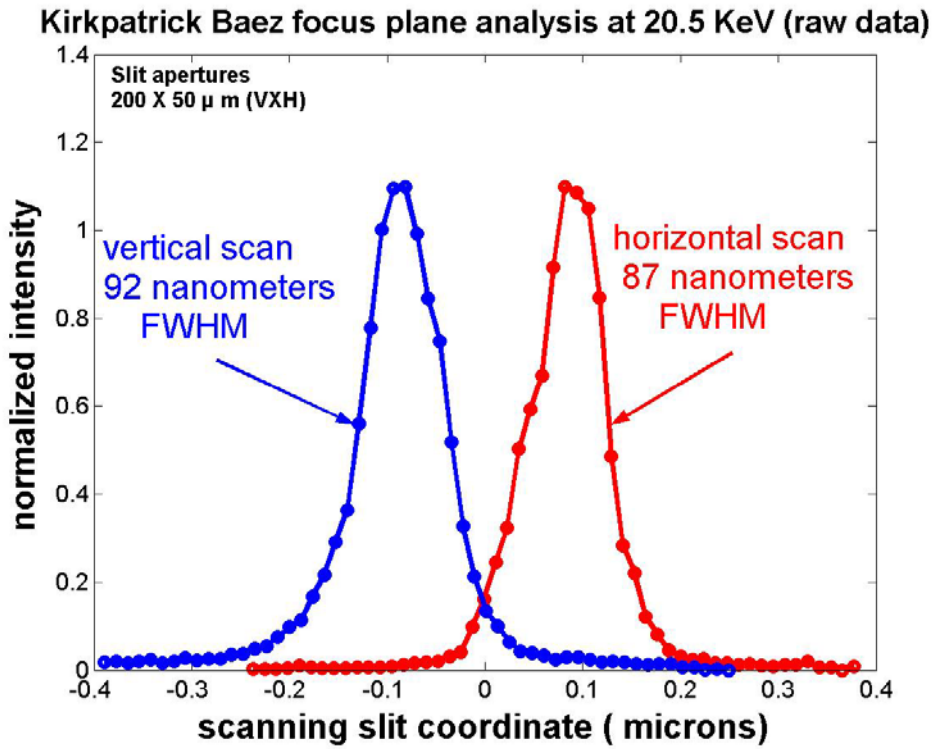
- Residual stress in (US) railway rails – 4 mm thick sample of worn rail
- ID11, 60 keV
- Used as test specimen for data reproducibility, positioning accuracy, costs etc
- Part of programme on engineering standards (VAMAS TWA20)

# Micrometer to Nanometer Focussing




- Kirkpatrick-Baez double multilayer mirror system
- Beams of < μm dimensions

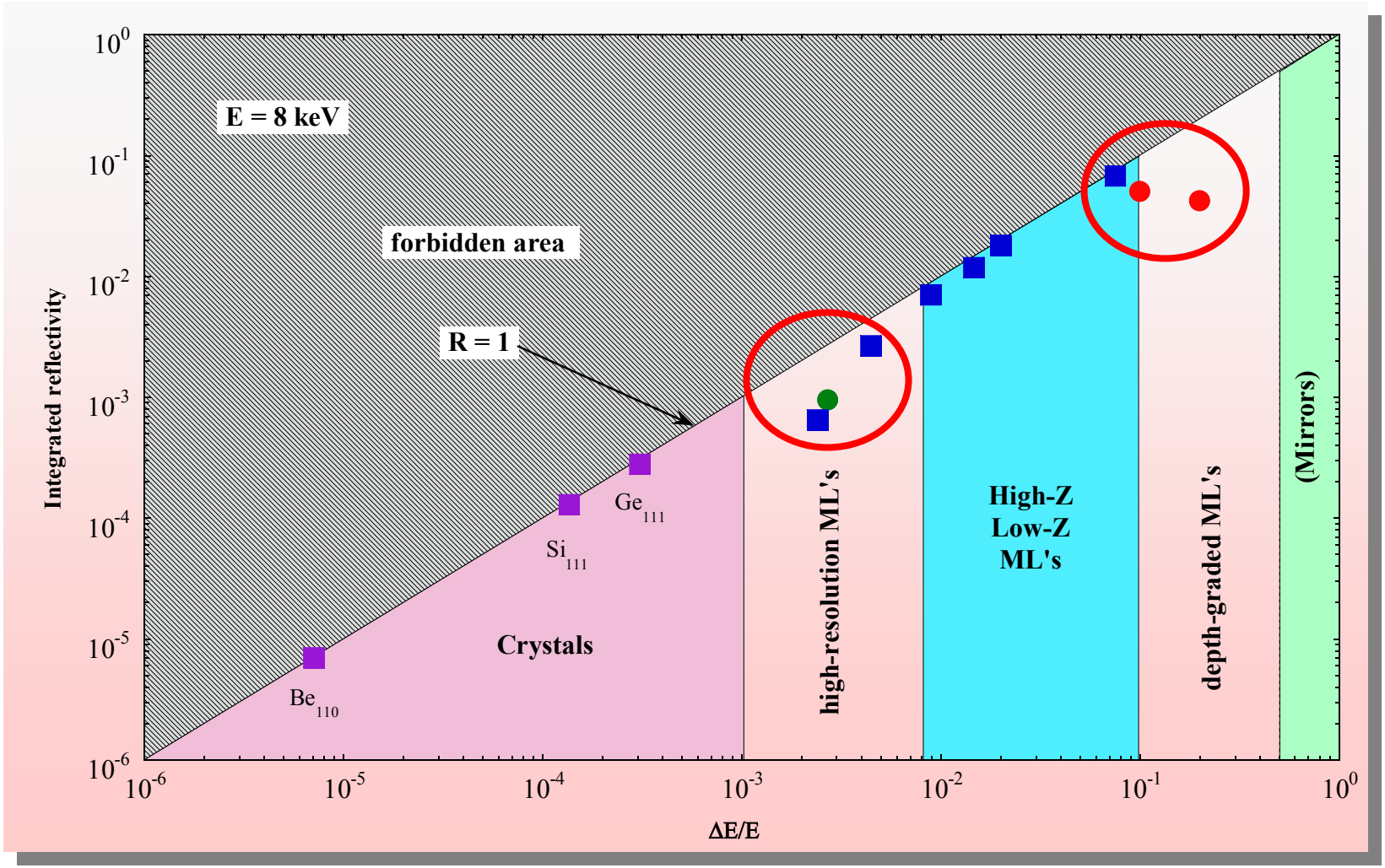
# Micrometer to Nanometer Focussing




20.5 keV

- Measured using fluorescence from Au layer < 70 nm
- Flux ~ 5 $10^{10}$ ($\Delta E/E=10^{-2}$) ph/s @ 80 mA (*Hignette, Cloetens)*

# Reflecting x-ray optics




(Morawe)

# Long Term Strategy

# (Long Term Scientific Plan)

# Long Term Strategy

## Major issues for ESRF over the next decade

- What is the ESRF's long term mission?
- Future directions for ESRF: continue as before or new scientific directions?
- International scientific context
  - Increasing pressure on science budgets
  - New national SR sources (SLS, BESSY II, SOLEIL, diamond …)
  - X-FEL projects (involvement in science and techniques ? …)
  - Involvement of European Union (FP6, FP7)

# Long Term Strategy

## Major issues for ESRF over the next decade

- ESRF's future status
  - Renewal of ESRF's Convention (first changes possible from 01/01/2008)
  - Membership changes (will all Member countries renew – at current levels ?)
  - New Associate countries (central and eastern Europe ?)
- Personnel
  - Disenchantment of students with science (enough international staff ?)
  - Crucial importance of outreach to the community

# Long Term Strategy

## Emerging ideas

### Science

- Centres of Excellence (e.g. PSB) – Materials Science ?
- New projects (e.g. Pulsed H Fields …)
- Micro → nano focussing (extreme thermodynamic conditions, coherent x-ray spectroscopy …)
- Sample manipulation (nano-samples) and sample environment (exotic and extreme)
- Beamline automation (optics → sample installation/changing → data-acquisition → data reduction)
- More applied science (e.g. magnetic imaging …)

# Long Term Strategy

## Emerging ideas

X-ray source

- Insertion devices (10 mm vacuum chambers, in- vacuum undulators, SC devices …)
- Development of HOM-damped RF cavity
- New lattice → improved emittance (horizontal) ?
- Upgrade ring with bypass → long straights (20 – 30m) ?
- New source (FEL, ERL…) ?
- Continue programme to improve reliability, stability of the current ring …

# Long Term Strategy

## Emerging ideas

### Infrastructure

- Detector developments (international effort)
- Data storage and transfer (impact of GRID ?)
- Optics developments (multilayer manufacturing laboratory, K-B systems …)
- New support laboratories (advanced sample preparation techniques …)
- New concepts for flexible use of space (long-term collaborations, industrial partners, CRGs …)
- Auditorium (jointly with ILL, EMBL, University ?)

# Long Term Strategy

## Next Stages of Discussion

- ESRF Medium Term Scientific Programme ("rolling" 5 year programme), in framework of long-term strategy of 1996
- New Long-term Scientific Strategy (10 years) under discussion
- Internal scientific and technical discussions during summer
- Discussions with Science Advisory Committee in Autumn 2003
- Input from Users' Meeting of February 2004

# Scientific Highlight *Sahelanthropus tchadensis:* the earliest known hominid (ID17, 2-3/5/03)

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- A new genus and species of hominid; Chad 6 –7 million years old (Late Miocene); imaging (inside skull, jaw, teeth) ID17
- Brunet, Vignaud et al (CNRS/U. of Poitiers Poitiers), Mission Paleonthropologique Franco-Tchadienne, et al (Nature 418 145 2002)

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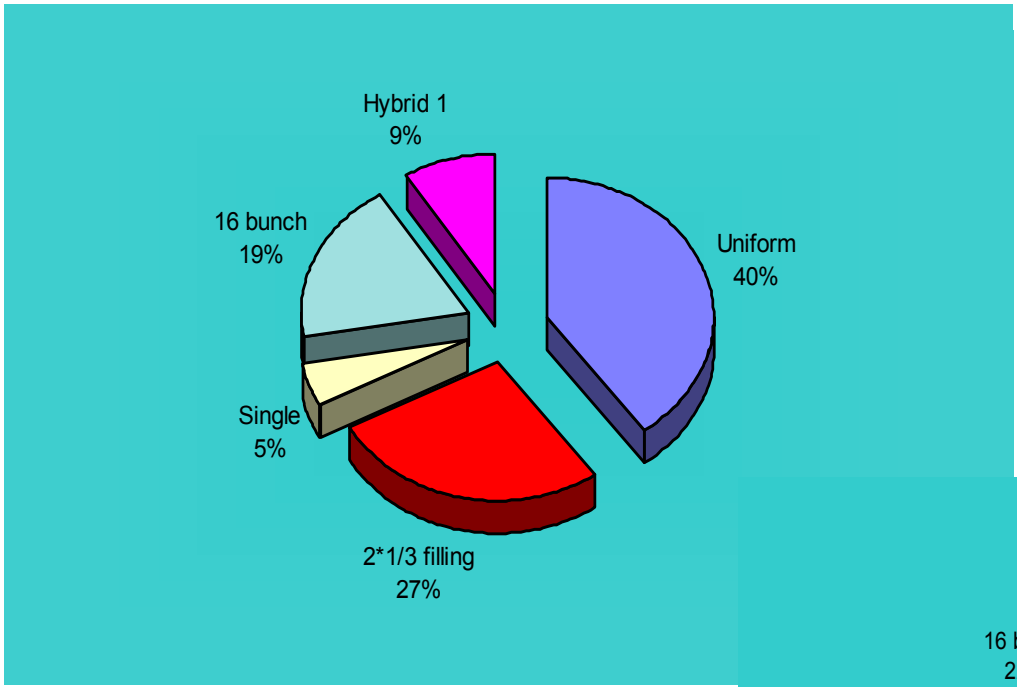
EUROPEAN SYNCHROTRON RADIATION FACILITY

# Machine filling modes




2002

2001